Energy Imbalance Market

Joe Taylor, Xcel Energy
Manager, Transmission Access
(303) 571-7642

Topic Outline

- Energy Imbalance Market Overview
- WECC EIM Design Proposal
- Variable Generation Integration
- Discussion, Next Steps and Q&A

Energy Imbalance Market (EIM) Overview

What is an EIM?

The EIM is…

- A Market for Balancing Energy
- Centralized Unit Dispatch for Balancing Energy
- Voluntary

The EIM is NOT…

- An RTO (with planning, day-ahead markets, etc.)
- Centralized Unit Commitment
- Capacity market
- A replacement for current contractual business structure

What is Imbalance Energy?

- Imbalance energy (or Energy Imbalance) is the difference between what actually happens for each generator and load location, and what they prearranged through schedules

Energy Imbalance = Actual Production or Usage – Scheduled Production or Usage

EI = A - S

- Asset owners are instructed to move their generation output based on offer curves while maintaining reliability and balance (matching generation to load)
- The amount of increase or decrease in generation is paid for by the asset owner needing the energy

EIM Highlights

- Resources may either be “Available” for market dispatch or “Self-dispatched” to serve scheduled transactions and/or native load
- Dispatch is regional and is calculated using a security constrained, offer-based economic dispatch (SCED) <u>every 5 minutes</u>
- Self-dispatched still subject to imbalance settlement if actual output does not match scheduled output
- Resources that have elected to be market dispatched (“Available”) will have their offered range subject to market dispatch control

What is the EIM?

- EIM provides asset owners the infrastructure necessary to offer their resources into the marketplace for use in providing Energy Imbalance.
- In the EIM, the Market Operator owns the responsibility of accounting for and financially settling all EI amounts.
  - Market Operator will remain revenue neutral

What is the EIM?

- The EIM does not supersede any MP's obligations with respect to any other capacity or ancillary service obligations.
  - Balancing Authorities (BA) and asset owners will continue to use the same procedures used today to manage capacity adequacy, reserves, and other reliability-based concerns.
- All MPs with load and/or resources within the market footprint will be subject to EI settlement under this market.
  - Any difference between scheduled and actual
- All asset owners must register with the Market Operator.

Features of EIM

- Uses regional security-constrained economic dispatch (SCED)
  - Balancing Area regulating burden drops to 5-minute variability instead of hourly
- Generators are dispatched based on voluntary market-based offers to transact energy
- Operational impact is projected to include increased reliability and reduced operating costs

Features of EIM

- Schedule using physical right
- Curtailment calculator tool assigns curtailment obligation based on transmission service priority
  - SPP uses IDC/CAT
  - WECC proposed ECC
- Market Price for imbalance, no penalty

WECC EIM Design Proposal

WECC EIM Design Proposal

- Adoption (generally) of SPP Market design
  - Many enhancements since 2007 market launch
    - Offer structure improvements
    - Congestion Management/TLR & CAT
- Proposal includes some transfer of reliability standards compliance obligations to regional operator
  - Actual standards to be determined by market participants and selected market operator

WECC EIM Design Proposal

- **Regional balancing market operator function but not an RTO nor an all-in regional transmission tariff**
  - **Transmission providers retain their own OASIS and Available Transfer Capability (ATC) calculations**
  - **“Imputed” transmission service charge without reservation, applied after-the-fact**

Variable Generation Integration

Variable Generation Integration

- "Traditional" BA operations focus on fixed hourly energy interchange (imports or exports) and all intra-hour balance between generation and load managed with internal resources
- This traditional style already poses significant operating challenges to some utilities in the Western Interconnection
  - Increasing load-following reserve duty in host balancing areas

Variable Generation Integration - Issues

- Wind is naturally uncontrollable in the up-direction
- Wind output usually highest at night and drops off during load pick-up
- Trip of multiple wind turbines in an area can become the largest single contingency in the footprint
  - Large wind drop-off events not yet characterized as a “contingency” by the industry

Variable Generation Integration - EIM

- **EIM SCED Solution repositions resources every 5 minutes to obtain the optimal economic and reliable solution**
    - **An added benefit is the solution counteracts volatility in resource output & load forecasting errors**

Next Steps / Discussion / Q & A

Upcoming EIM Activities

- WECC BOD meetings June, September and December
  - WECC B/C analysis of EIM scheduled for the June BOD meeting
  - WECC organizational and regional risk assessment of the EIM proposal scheduled for the September BOD meeting

Critical Decisions Remain

- Individual utility analysis of costs/benefits
- Critical Mass of utilities
  - WestConnect Participants
  - Columbia Grid
  - Northern Tier
- Organizational identity for the market operator
  - WECC?
  - Contract with SPP or other existing market?
  - Software Developer?

Critical Decisions Remain

- Mid-level design specification sufficient to get a specific implementation cost estimate.
  - WECC cost analysis has a wide range based on desired structure and services
- Tariff development & cost recovery for:
  - the EIM itself
  - the balancing area cost to prepare for startup
- Revenue distribution methodology for EIM-based transmission service, which is a novel feature of the EIM proposal compared to other regional markets.

Critical Decisions Remain

- Establishment of funding and financing for the EIM startup
- Establishment of Seams Coordination Agreements between the EIM footprint, Non-EIM participants, and the CAISO

Xcel Energy®

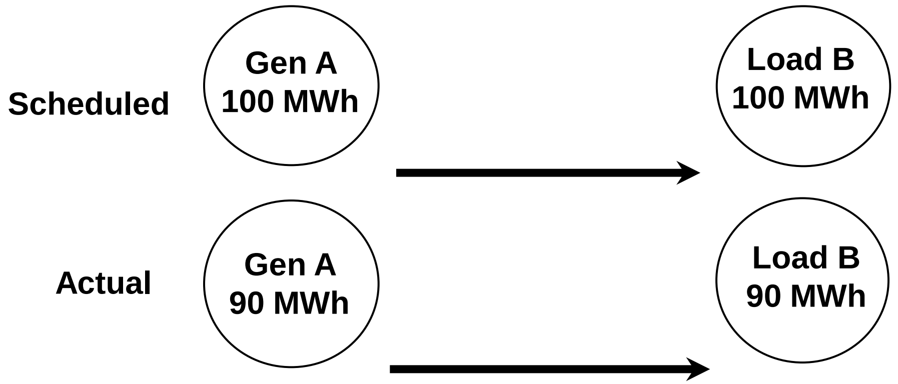
Additional Information

Imbalance Energy Example

Generator A is scheduled to provide Load B 100 MWh of energy.

But at the end of the hour, the energy output of Generator A was only 90 MWh, and the energy consumption of Load B was also only 90 MWh.

Has an imbalance occurred in this situation?



Note: Generation Injections are (-) and Load Withdrawals are (+)

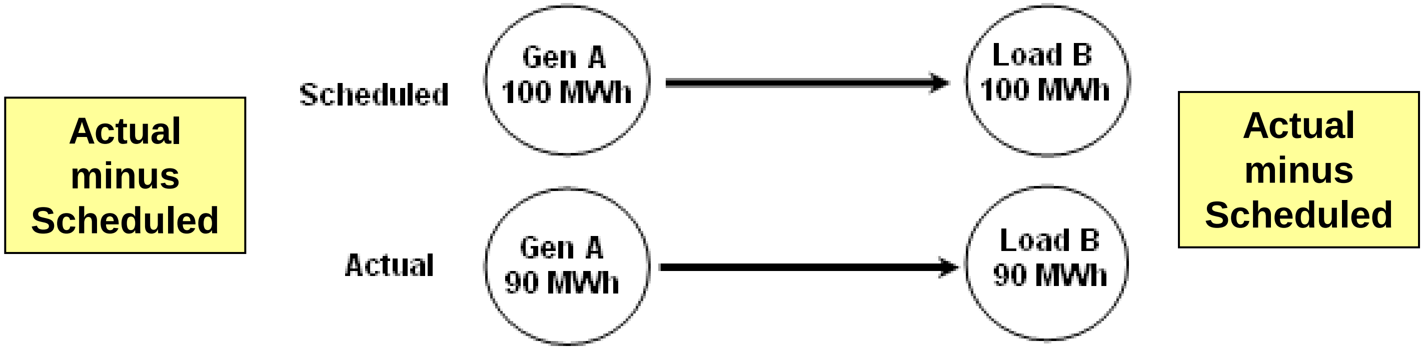
Imbalance Energy Example

Imbalance (Gen A) = (-90 MWh Actual) – (-100 MWh Scheduled)

Imbalance (Gen A) = 10 MWh

Imbalance (Load B) = (90 MWh Actual) – (100 MWh Scheduled)

Imbalance (Load B) = -10MWh

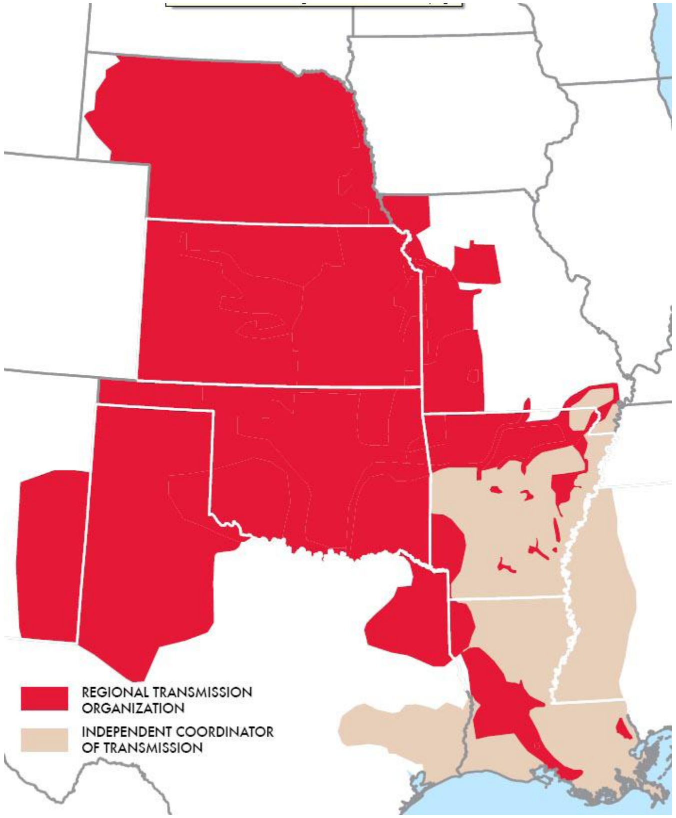


Notice that even though the *system* was in balance (generation matched load), by definition there was an imbalance at each location. Actual and Scheduled were not equal.

Southwest Power Pool (SPP) Experience

SPP Organization

- Founded in 1941
- 1991 – Implemented Reserve Sharing
- 1997 – Reliability Coordination
- 1998 – Tariff Administration
- 2001 – Regional Scheduling
- 2004 – FERC approved RTO
- 2007 – Launch of EIS Market
- 2014 – Launch full LMP/ASM
- SPP Inc
  - RTO and Regional Reliability Organization
- SPP 45 GW peak load (Market Footprint)
- 16 BAs



SPP EIS Market Launch

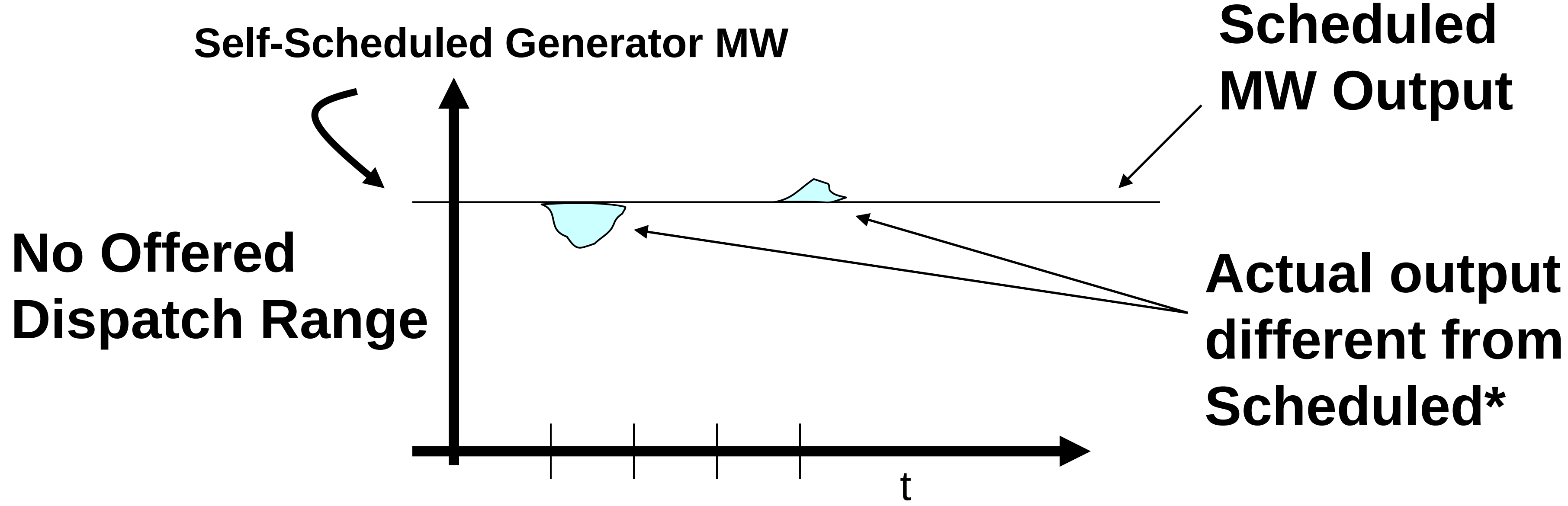
- February 1, 2007
- Novel design
- Low Cost
  - Ongoing enhancement/improvements
- SPP EIS Market economic benefits
  - SPP-wide: $103 million in economic benefits (2007), 20% higher than C/B study predicted

Market Participation

Self-Dispatched Resources Introduction

- Dispatch value will be the sum of all schedules
- These resources may only be dispatched outside of the sum of the schedules in a system emergency (a manual dispatch instruction sent by the Market Operator).

“Self-Scheduled Only”

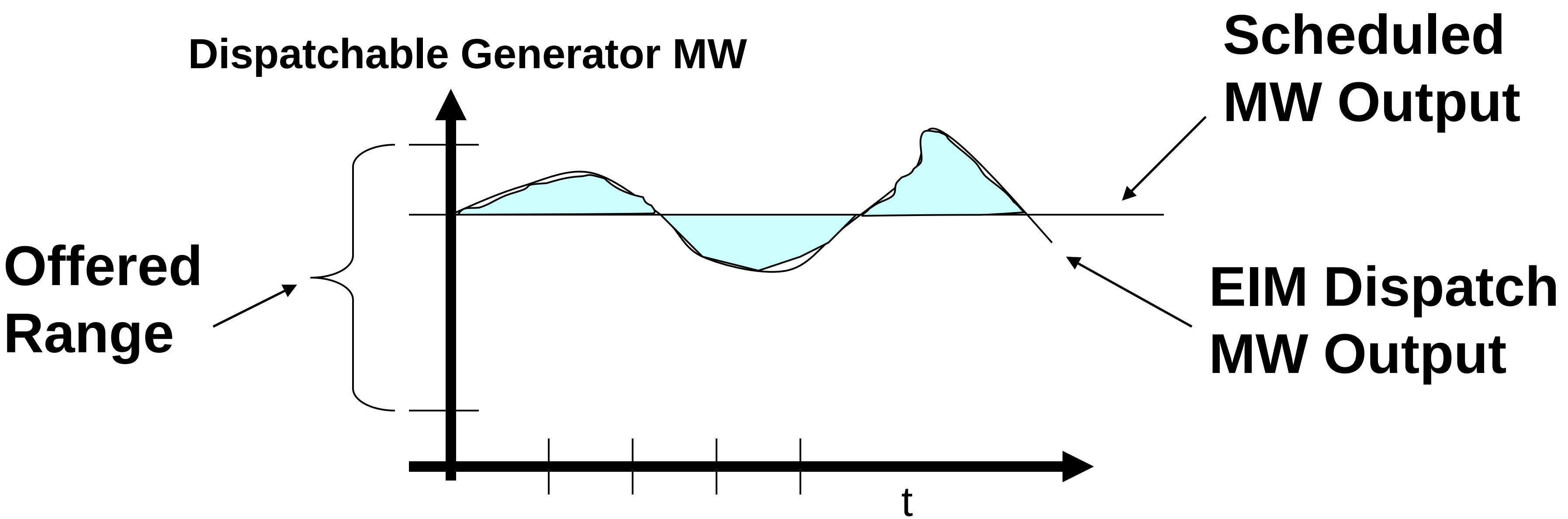


There is a non-zero EIM settlement for this Generator during hours where “Actual MWH” not equal to the “Scheduled MWH”

Transmission service priority for Scheduled MW = OATT basis.
Priority for EIM dispatch = 0

**Such differences may occur in normal operations due to plant conditions, for example.*

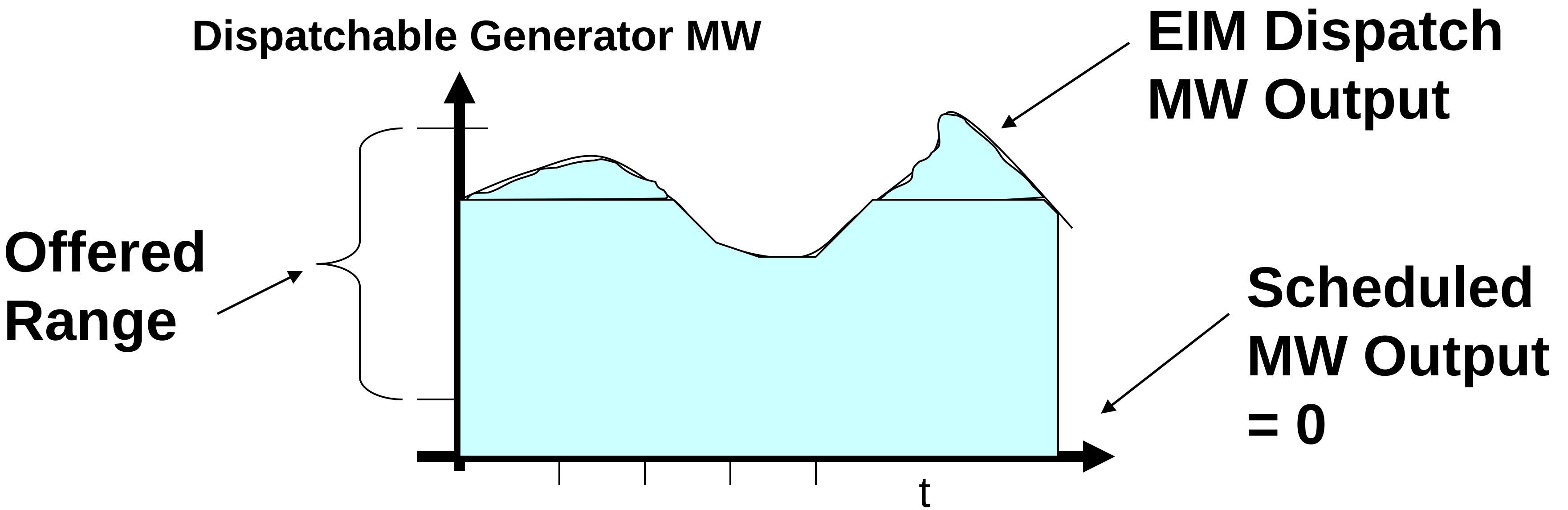
"Offered and Scheduled"



Blue volumes netted for the hour and paid this net volume times the hourly integrated Locational Imbalance Price.

Transmission service priority for Scheduled MW = OATT basis. Priority for EIM dispatch = 0

"Offered" or "Manual" or Price-Taker", No Schedule



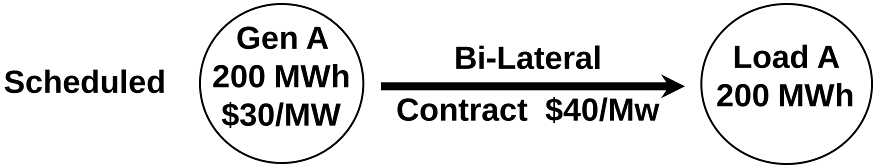
Dispatchable Generator credited for entire output volume times the hourly integrated Locational Imbalance Price.

Transmission service priority for EIM dispatch = 0

Example 1: No Market Participation

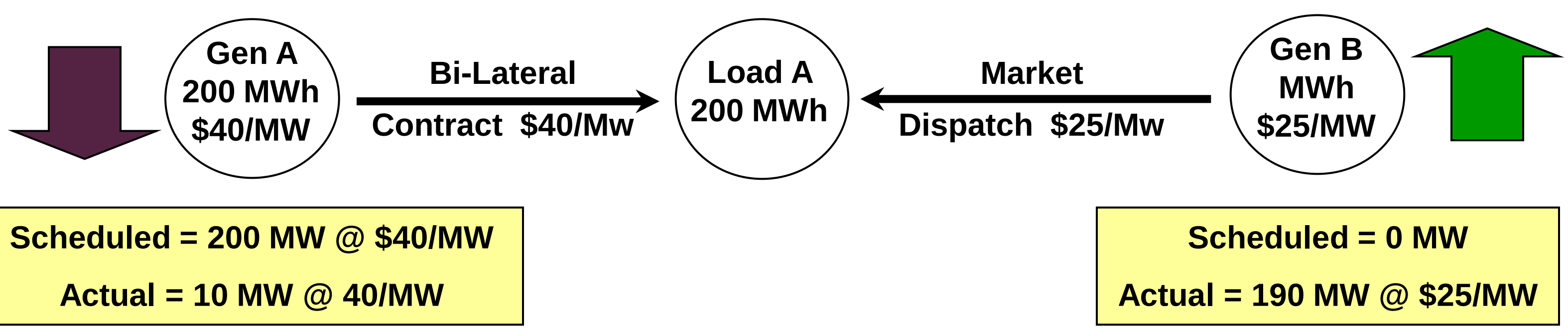
- GenA has a bilateral contract with Load A and schedules 200 MWh at $40/MWh to Load A.
- It costs GenA $30/MWh to produce the energy.
- Generator A has a profit of:

($40/MWh - $30/MWh) x 200 MWh = $2,000



Example 2: Market Participation

- GenA and Load A have a bilateral schedule for 200 MWh.
- GenA also decides to offer its generation into the market @ $40/MWh.
- The EIM can provide energy @ $25/MWh from other resources.
- Therefore, GenA instructed to go to Min MW (10 MW) because its price is higher than the LIP.



Example 2: Market Participation

Gen A EIS = (Actual – Scheduled) x LIP

Gen A EIS = [-10 MWh – (-200 MWh)] x $25/MWh

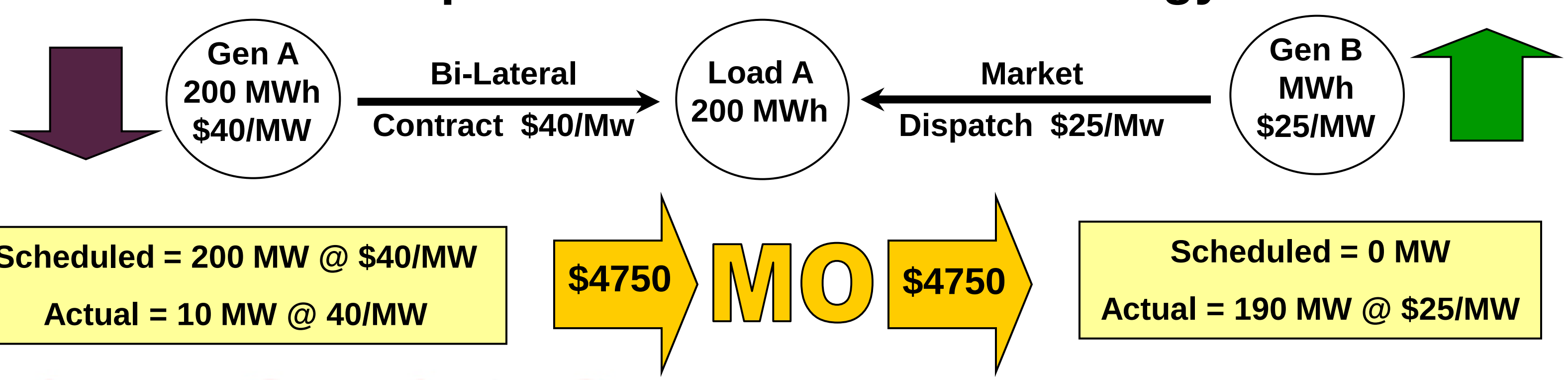
Gen A EIS = 190 MWh x $25/MWh

Gen A EIS = $4,750 (Paid to market)

A positive value

GenA pays market $4,750

Market Operator disperses this money to the generator(s) that provided the 190 MW of energy.



Example 2: Market Participation

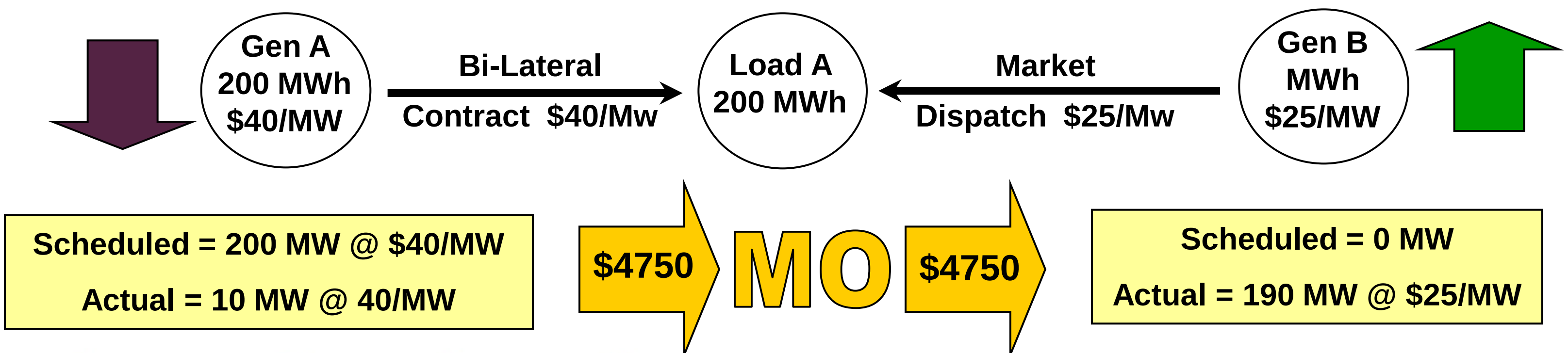
Gen B EIS = (Actual – Scheduled) x LIP

Gen B EIS = [-190 MWh – (0 MWh)] x $25/MWh

Gen B EIS = -190 MWh x $25/MWh

Gen B EIS = - $4,750 (paid to this resource) A negative value

Market Operator pays Gen B $4,750



Example 2: Market Participation

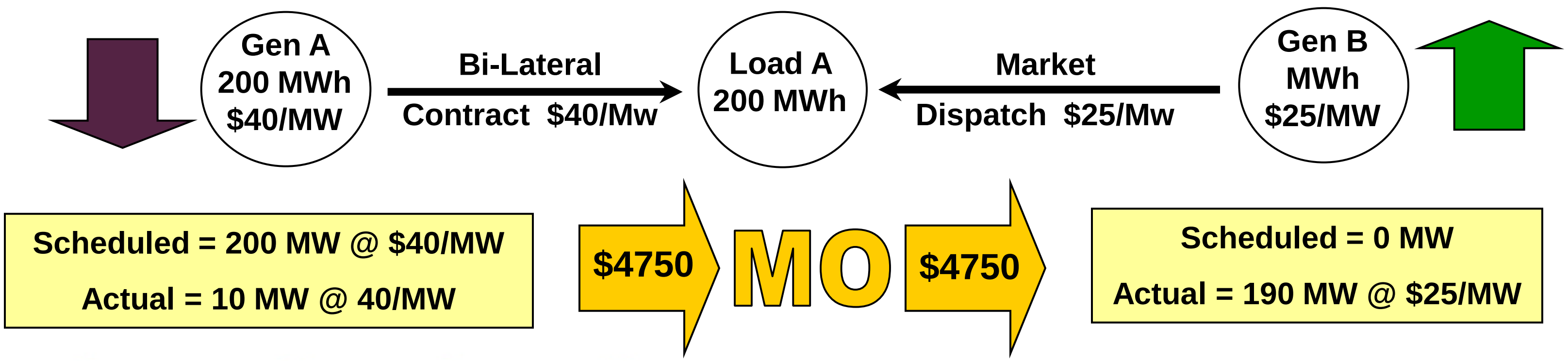
Load A EIS = (Actual – Scheduled) x LIP

Load A EIS = (200 MWh – 200 MWh) x $25/MWh

Load A EIS = 0 MWh x $25/MWh

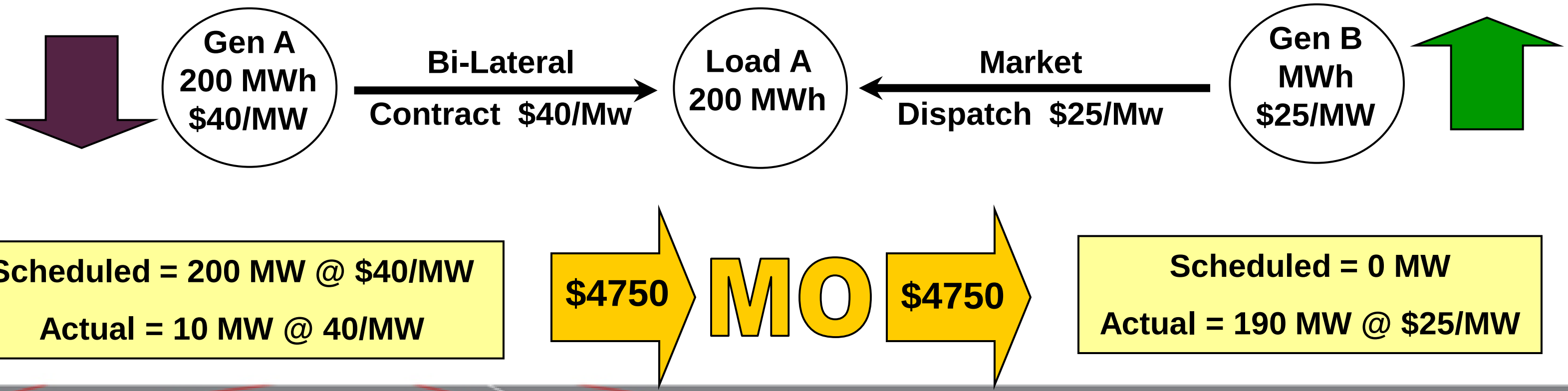
Load A EIS = $0 ← **No change to scheduled withdrawal**

Load A pays no EIS



Example 2: Market Participation

- GenA paid market $4,750 in lieu of spending $5,700 to generate the 190 MWh of energy itself.
  - This saved GenA $950 by offering the resource to the Market
- GenA continues to receive compensation from load A under its bilateral agreement (200MWh x $40/MWh) of $8000.
- GenA profits increased from $2000, to $2950



Market Participation Comparison

GEN	NO MARKET PARTICIPATION	MARKET PARTICIPATION	MARKET PARTICIPATION
Rev. = $40 x 200 MWh Cost = $30 x 200 MWh	$8,000 - 6,000 $2,000	(LIP $25/MWh)	(LIP $50/MWh)
Rev. = $40 x 200 MWh Cost = $30 x 10 MWh $25 x 190 MWh		$8,000 - 300 - 4,750 $2,950	
Rev. = $40 x 200 MWh Cost = $30 x 200 MWh	Note: Profit on the bilateral is not affected by the LIP		$8,000 - 6,000 $2,000

LOAD Settlement

200 MWh – 200 MWh = 0 in any scenario, so load is not impacted.

Offer Curves

Offer Curves in the Market

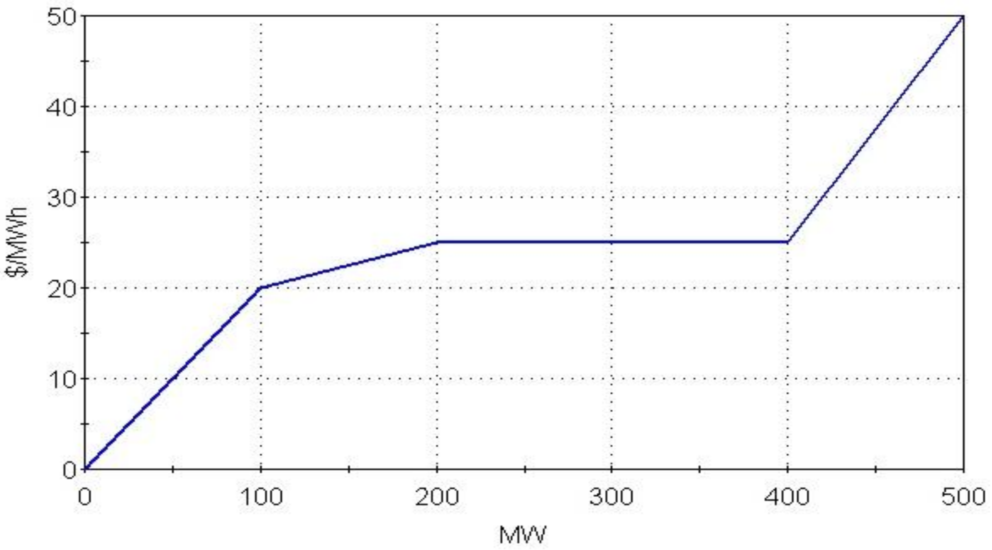
- Offer Curves
  - Used by market system in determining the most economical dispatch of Market resources
  - Used in the calculation of LIP (Locational Imbalance Pricing)
  - Used with “Available” resources
  - Price of resource is specified through an offer curve

Offer Curves in the Market

- Resources that offer energy into the EIM must specify an offer price.
- The Offer Curve allows resources to offer multiple MW points at different prices.
- An offer curve is submitted for each resource and contains between two to ten monotonically increasing pairs of MW and price.

Submitted Data

(MW)	$
0	$0.00
100	$20.00
200	$25.00
400	$25.01
500	$50.00



Settlements

Introduction to Settlements

- The purpose of the settlement process is to:
  - Calculate quantity of energy imbalance for each asset
  - Calculate invoice dollars for energy imbalances
  - Allocate over- and under-collection of revenues to asset owners

Introduction to Settlements

- Each registered asset becomes a settlement location.
- Resources settled based on LIP associated with their settlement location.
- Load may choose to be settled either zonally or nodally.
- Resources that are self-dispatched will be responsible for any imbalance charges. They cannot "opt out."
- The market will be facilitated such that the Market Operator will remain revenue neutral.